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Contaminated soil/groundwater remediation using Permeable Reactive Barrier (PRB) techniques

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Soil/water demonstration models made from clear perspex are being developed by FOES USQ to observe the performance of crushed charcoal /biochar PRB for removing organic contaminants. Further development of the project will investigate the potential for biochar PRB enhanced with enzymatic bioremediation technology, specifically developed to treat pesticide and nitrate residues in soils and groundwater.

It is now becoming firmly established that are better approaches to the traditional 'pump-and–treat' methods for contaminated groundwater remediation operations (USEPA, 1998). The advantage of in-situ treatment is obvious – and several successful operations have been documented (USEPA 2002). For example, use of ground iron based reactive barriers for TCE to ethane, Cr(VI) to Cr(III) and some heavy metals (FRTR 2002). The potential for this relatively new and emerging technology for Australian groundwater contamination problems, whether existing or future case scenarios, is quite significant. The potential for phosphorus impregnated nutrient walls which promote anaerobic or aerobic microbial degradation of BTEX, oil, grease and other petroleum hydrocarbons is of particular interest. The passive but effective nature of the PRB based soil/water pollution control is becoming very attractive to operators, particularly in terms of its potential for long term cost savings.

There is presently a move away from using live microbes for pesticide/nutrient bioremediation, because of the problem of keeping the microbes supplied with precise levels of oxygen, nutrients and water under difficult conditions. There has been much recent progress in the area of enzymatic bioremediation (Scott et al 2010). These enzymes are often found in insecticide resistant insects or weeds.

The problem of pesticide and nutrient runoff into Australia's Great Barrier Reef is well understood (Henderson and Croon 2009, Reef Rescue 2010). Runoff of contaminated soil and groundwater (which flows to the reef during storms) needs to be addressed with effective environmental engineering based solutions. Industry and government need to embrace and action any new technology which may reduce impacts on our reef which generates over 5 billion dollars for Australia from tourism.

PRB technology needs to be developed to neutralize nutrients and pesticides (specifically ametryn, atrazine, diruron, hexazinone and tebuthiuron). Deployment of and testing of this this technology needs to take place across the various grazing, sugarcane and horticultural industries in Queensland. The potential for green or brown biochar products, which could be readily manufactured from farm waste, will be investigated in this regard.

Surface runoff is managed by retention lagoons facilitating water reuse on-farm. Loss of contaminated water via field deep drainage presents a much tougher problem which up until now has not been satisfactorily addressed. The challenge for engineers is to come up with in-situ PRB designs which are efficient, cost effective and which will be taken up and embraced by the various agricultural industries located along Australia's eastern coastal fringe.

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